Regularities in the kinetics of martensitic transformations. (Cont.)

the process of formation of the nuclei. Thus, thermal motion appears to be one of the main factors which govern the kinetics of martensitic transformation, as well as other phase transformations.

The alloy of iron and 23% Ni, 34% Mn (5). Isothermal transformation was investigated in the range room temperature to -130 C. As the temperature decreases, the initial reduced speed of isothermal transformation, given by

$$N' = \frac{1}{V'_o} \left(\frac{dV}{dt}\right)_{t=0} 100$$

at first increases, at -50 C it reaches a maximum, and thereafter decreases and has very small values below -160 C (Fig.1; where V - volume of martensite, formed at the starting moment of the isothermal process (in %), V'_o - that part of the volume of the specimen which can be transformed at the given temperature (in %), t - duration of the isothermal process). If the low energy of thermal oscillations is the factor limiting the speed of formation of nuclei on the low temperature side of the maximum, then the rapidly

Regularities in the kinetics of martensitic transformations. (Cont.)

increasing work of formation of the nuclei, with increasing temperature, is the corresponding factor on the high temperature side as shown in earlier work of the authors(6,7). Steel 85Г2$_2$, containing 0.85% C and 2.2% Mn, see Fig.2 (6,7, 13). If the cause which makes possible observation of isothermal transformation in the temperature range approaching the martensite point is the high work of formation of martensite nuclei, an increase of the transformation speed should occur with decreasing temperature. To elucidate the problem the experiments were made with this steel, the martensite point of which is about 155 C. It was found that in this steel the initial reduced speed of isothermal transformation N' increases at first with decreasing holding temperatures below the martensite point and then becomes unusually high in the range between room temperature and -50 C, dropping sharply with further decreases in temperature (Fig.2). It is concluded that the absence of isothermal transformation at room temperatures, and the occurrence of the transformation on cooling only, is conditioned not by some non-thermal process, but by the higher speed of thermal formation of martensite crystals.

Regularities in the kinetics of martensitic transformations. (Cont.)

Steel containing 0.95% C and 3.5% Mn. (Fig.2 ref.14). Isothermal formation of martensite in this steel was observed in the whole temperature interval of martensite transformation. This case is denoted by 95Г3$_5$ in Fig.2. Maximum of N' occurs at +25°.

Fe-Ni-Mn alloys (shown in the table on p.7 where the first column gives the Russian designation of the alloy and the last column gives the martensite point). Fig.3 shows the initial parts of curves of isothermal martensitic transformation of the alloy H24Г3 (23.8% Ni, 3.2% Mn) - where M is the amount of martensite, t - is the time in minutes. Fig.4 shows the temperature dependence of the initial speed of isothermal martensitic transformation N, for Fe-Ni-Mn alloys having different martensite point T_m; t is the time in seconds. The changes in T_m have no effect on the position of the lower temperature limits of the transformations (for the three alloys), they all lie near the boiling point of nitrogen.

On the basis of their own results and literary data, the authors conclude that it can be considered as a well proved established fact that the temperature dependence of the

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Regularities in the kinetics of martensitic transformations. (Cont.)

speed of transformation of austenite into martensite is a characteristic feature of all phase transformations. Thermal oscillations of atoms in the lattice are therefore one of the basic factors determining the kinetics of martensite transformations. "Athermal" transformations are in reality the result of thermal formation of nuclei which takes place at very high speed under certain conditions (low work of formation of the nuclei at large degrees of super-cooling, high energy of the thermal oscillations at temperatures which are not low enough). Presence of locations which are "prepared" for forming nuclei lead only to an increase in the temperature at which nuclei would form at these locations owing to thermal fluctuations.

There are 5 figures and 38 references, 24 of which are Slavic.

SUBMITTED: March 20, 1957.

AVAILABLE:

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AUTHORS: Kurdyumov, G. V., Member of the Academy, Maksimova, O. P., Nikonorova, A. I. 20-114-4-25/63

TITLE: The Activating Influence of Plastic Deformation on Martensite Transformation (Ob aktiviziruyushchem vliyanii plasticheskoy deformatsii na martensitnoye prevrashcheniye)

PERIODICAL: Doklady Akademii Nauk SSSR, 1957, Vol. 114, Nr 4, pp. 768-771 (USSR)

ABSTRACT: The present paper is intended, among other things to confirm the opinions on the influence exercised by stresses on the activation of the transformation. The authors investigated the rules of the restoration of the original stability of austenite on the occasion of annealing at gradually increasing temperature. The change of the stability of the austenite resulting from a plastic deformation or from the following annealing was judged by the strength of the magnetometric effects in the temperature domain below room temperature on the occasion of the transformation of austenite into martensite. It was assumed that the activating influence exercised by the deformation can easily be determined in such alloys which possess sufficiently marked elastic properties. The authors

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therefore selected iron-chromium-nickel alloys for the investigations. The composition of the alloys used is given. In the case of both alloys the resistance of the austenite changes inhomogeneously with an increasing degree of deformation. The following was observed at increasing pressure: At first an increase of the intensity of martensite transformation compared to the non-deformed state took place, then the activating influence exercised by deformation became weaker and above a certain pressure the martensite transformation was slowed down. Such a character of the modificati- of the resistance was observed at 20°, 100°, and 175°C. A deformation of 5% increases the martensite point as well as the amount of martensite considerably. After a deformation by 7,4% the total amount of martensite increases to 20%, and with a further deformation the transformation effects become weaker. After a deformation of 14,7% the effects are already weaker than in the initial state. When annealing at temperatures of up to 400° the resistance of the deformed austenite increases but when annealing beyond 400° the resistance decreases. The activation influence exercised by the deformation seems to be subjected to the occurrence of

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KURDYUMOV, G.V., otvetstvennyy red.; SAMARIN, A.M., red.; SHVARTSMAN, L.A., red.; MALKIN, V.I., red.; GOLIKOV, V.M., red.; RABEZOVA, V.A., red.; CHERNOV, A.N., red.izd-va; SIMKINA, Ye.N., tekhn.red.; KASHINA, P.S., tekhn.red.

[Metallurgy and physical metallurgy proceedings of the Conference on the Use of Radioactive and Stable Isotopes and Radiation in the National Economy and in Science] Metallurgiia i metallovedenie; trudy Vsesoiuznoi nauchno-tekhnicheskoi konferentsii po primeneniiu radioaktivnykh i stabil'nykh izotopov i izluchenii v narodnom khoziaistve i nauke. Moskva, Izd-vo Akad. nauk SSSR, 1958. 518 p. (MIRA 11:6)

1. Vsesoyuznaya nauchno-tekhnicheskaya konferentsiya po primeneniyu radioaktivnykh i stabil'nykh izotopov i izluchenii v narodnom khozyaystve i nauke. 1957.
(Metallurgy) (Physical metallurgy)

KURDYUMOV, G. V.

18(0) PHASE I BOOK EXPLOITATION SOV/1728

Akademiya nauk SSSR. Institut metallurgii

Sovremennyye problemy metallurgii (Modern Problems in Metallurgy) Moscow, Izd-vo AN SSSR, 1958. 640 p. 3,000 copies printed.

Resp. Ed.: A.M. Samarin, Corresponding Member, USSR Academy of Sciences; Eds. of Publishing House: V.S. Rzhevnikov, and A.N. Dormov; Tech. Ed.: T.V. Polyakova.

PURPOSE: This book is intended for scientific and technical personnel in the field of metallurgy.

COVERAGE: This is a collection of articles on certain aspects of Soviet metallurgy. The book is dedicated to Academician Ivan Pavlovich Bardin on the occasion of his 75th birthday. The book is divided into seven parts. The first part consists of two articles presenting a brief account of the biography and professional activity of the Soviet metallurgist. It includes an article by John Chipman, Nicholas Grant, and John Elliott (M.I.T., USA) describing their meeting with Bardin in Moscow and also his visit to the United States. The second part consists of three articles and deals with raw materials and fuels for the Soviet metallurgical industry. The third part represents the major portion of the book. It consists of 25 articles dealing with the various aspects of the metallurgy of pig iron and steel. The fourth part consists of two articles treating the metallurgy of nonferrous metals. The fifth part consists of three articles on the forming of metals. The sixth part consists of eight articles discussing certain aspects of physical metallurgy. The last part deals with general problems in the field of metallurgy. References are given after each article. No personalities are mentioned.

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KURDYUMOV, G.V.; BIL'DZYUKEVICH, I.A.; KHANDROS, A.G.; CHERNYY, V.G.

Changes of the fine crystalline structure during the aging of nickel and iron-nickel-base alloys. Issl. po zharopr. splav. 3:183-188 '58. (MIRA 11:11)

(Nickel alloys--Metallography)

KURDYUMOV, G. V.

PHASE I BOOK EXPLOITATION 983

Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii. Institut metallovedeniya i fiziki metallov

Problemy metallovedeniya i fiziki metallov (Problems of Physical Metallurgy). Moscow, Metallurgizdat, 1958. 603 p. (Series: Its: Sbornik trudov, v. 5)

Eds.: Lyubov, B.Ya. and Maksimova, O.P.; Ed. of Publishing House: Berlin, Ye.N.; Tech. Ed.: Karasev, A.I.

PURPOSE: This book is intended for scientists and engineers working in the field of physical metallurgy.

COVERAGE: The articles in the book present the results of investigations conducted by the issuing body, the Institut metallovedeniya i fiziki metallov (Institute of Physical Metallurgy), a part of the Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii (Central Scientific Research Institute of Ferrous Metallurgy), located in Dnepropetrovsk. The investigations were concerned with phase transformations in alloys, strengthening and softening processes, diffusion processes (studied with the aid of radioactive isotopes), and certain other questions. The studies conducted at the institute by V.I. Danilov in the fields of atomic and molecular structure of liquids and of crystallization processes are stated to have received wide recognition.

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AVAILABLE: Library of Congress

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KURDYUMOV, G.V. [Kurdiumov, H.V.]; BIL'DZYUKEVICH, I.A. [BIL'DZIUKEVYCH, I.A.]; KHANDROS, L.G. [Khandros, L.H.]; CHERNYY, V.G. [Chornyi, V.H.]

Change in the fine crystalline structure of some heat-resistant alloys during aging [with summary in English]. Ukr.fiz.zhur. 3 no.4:495-505 Jl-Ag '58. (MIRA 11:12)

1. Institut metallofiziki AN USSR.
(Heat-resistant alloys--Metallography)

KURDYUMOV, G.V.

126-5-3-12/31

AUTHORS: Golubkov, V.M., Il'ina, V.A., Kritskaya, V.K., Kurdyumov, G. V. and Perkas, M.D.

TITLE: Study of the Physical Factors which Determine the Hardening of Alloyed Iron (Izucheniye fizicheskikh faktorov, opredelyayushchikh uprochneniye legirovannogo zheleza)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 5, Nr 3, pp 465-483 (USSR)

ABSTRACT: This paper is devoted to the study of the physical factors which determine the hardening of α-iron alloyed with various elements; considering only hardening which is due fully to changes in the fine structure of the α-solid solution without any changes in its chemical composition. In the experiments iron was used alloyed with various elements; the chemical compositions of the respective binary alloys of iron are entered in Table 1, p.465. The material was produced in a high frequency furnace with ingot weights of 25 kg. All the ingots were subjected to diffusion annealing at 1200°C for twenty hours. After homogenization annealing, the ingots were forged to a square 50 x 50 mm. After forging most of the ingots were annealed for the purpose of obtaining a uniform grain size. After forging and annealing, the

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blanks were cold rolled with a total reduction of 80% and from the produced strips flat specimens were cut which were used for measuring the hardness and also for micro-mechanical investigations. The alloys Fe + 3% Mn, Fe + 4% Ni, Fe + 8% Cr were also hardened by quenching in a 10% NaOH solution after the specimens have been heated in a salt bath to 1000°C. The alloys Fe + 3% Mn, Fe + 0.5% Ti, Fe + 0.6% W and non-alloyed iron were also used for studying the influence of step-wise deformation on the changes in the characteristics of the fine structure. Specimens with initial dimensions of 70 x 15 x 8 mm were deformed in the cold state (on a laboratory rolling stand) with reductions of 5, 10, 15, 20, 30, 50, 80 and 90%. The characteristic of the fine structure was also studied on filings obtained from the alloys Fe + 1.84% Co, Fe + 1.8% Mo, Fe + 2.28% V, Fe + 3% Mn, Fe + 4% Ni, Fe + 8% Cr. Distortions of the third type and the characteristic temperature were determined predominantly on specimens produced from powders. The fundamental methods of studying the influence of alloying elements on

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the hardening of the ferrite were: X-ray structural analysis and mechanical tests. The authors investigated the relation between the fine crystalline structure of α-iron base solid solutions in the work hardened state and also some of the mechanical properties of these alloys. Hardening of the alloys was achieved by cold plastic deformation as a result of the martensitic γ to α transformation mechanism. For changing the properties of the crystals of α-iron in the micro and sub-micro ranges (properties of the crystal lattice of the α-solid solution), the iron was alloyed by various elements, namely: Si, Ti, V, Cr, Mn, Co, Ni, Nb, Mo, W. By means of X-ray structural methods the following properties of α-phase crystals were studied in the sub-micro regions: static lattice distortions caused by the presence of foreign atoms in the lattice; dynamic displacements of the atoms during thermal oscillations and the characteristic temperature; magnitude of the elastic deformation of the lattice caused by cold plastic deformation. As characteristics of the fine crystalline structure of the alloys in the hardened state the following were applied: size of the regions of the

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coherent scattering of X-rays (mosaic block), distortions of the second type and of the third type. The mechanical properties of the micro-volumes were characterised by the hardness, the yield point and the strength values. The results led to the following conclusions:

1. A characteristic feature of alloys in the hardened state obtained by a high reduction in the cold state or as a result of the γ to α martensitic transformation is the low value of the regions of coherent scattering of X-rays. The size of these regions for all these alloys is within the limits of 200 to 400 Å. The observed difference in the size of the blocks is near to the limit of the error in measuring them. However, the strength characteristics change within wide limits on changing over from one alloy to another (hardness, H_V between 172 and 340; σ_s between 54 and 113 kg/mm^2). Thus, the great difference in the resistance to deformation of various alloys in the hardened state cannot be attributed to changes in the sizes of the blocks.

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2. The presence of various elements in the solid solution

influences to a considerable extent the type II distortions (non-uniform micro-stresses) in deformed as well as in hardened alloys. A correspondence exists between the magnitude of these type II distortions and the strength values of alloys in the hardened state.
3. High degrees of plastic deformation bring about considerable type III distortions. In the investigated solid solutions considerable displacements of the atoms take place in alloys in the annealed state, which is caused by the presence in the atom lattice of dissolved elements; $\sqrt{\bar{u}^2_{cm}}$ varied between 0.058 and 0.120 Å ($\bar{u}^2_{cm}$ being the magnitude of the static displacements of the atoms). After deformation with a high degree of reduction in the cold state (filings) the magnitude of $\sqrt{\bar{u}^2_{cm}}$ increased approximately to the same level (about 0.100 to 0.120), which is near to the level of type III distortions in cold deformed non-alloyed iron. The higher the value of $\sqrt{\bar{u}^2_{cm}}$ for the "equilibrium" solid solution, the smaller was the change

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in this magnitude as a result of the deformation.
4. After hardening of the alloyed iron to martensite, the magnitude of the static displacements did not increase. Thus, in alloys hardened by means of martensitic transformation no type III distortions occur, although the strength characteristics approach those of materials deformed in the cold state. This could be seen particularly clearly on specimens of pure iron, hardened to produce martensite. No type III distortions were detected and hardening, block sizes and type II distortions were on the same level as in the case of iron deformed in the cold state. Consequently, presence of type III distortions at least of a magnitude detected in measurements by means of intensive X-rays is not a necessary condition for obtaining a high resistance to deformation.
5. Investigation of the fine crystalline structure as a function of the degree of plastic deformation carried out on pure iron and on some solid solutions has shown that with increasing degree of deformation the hardness, the type II and type III distortions increase, whilst the sizes of the

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blocks decrease. These characteristics change most rapidly for low degrees of deformation; for deformations of 30 to 70% the change of these characteristics is slow. For higher degrees of deformation the speed of the change in the characteristics increases again. The behaviour of the metal in the case of very high degrees of plastic deformation requires further detailed investigation.

6. The obtained results permit the conclusion that breaking up of the regions of coherent scattering is a necessary condition for increasing the resistance to deformation of the metals (in the case of the "sliding" mechanism of plastic deformation). The differences in the absolute magnitudes of the characteristics of the resistance to deformation for various metals and solid solutions is due mainly to the differing properties of the crystals in the micro and sub-micro regions (character and force of the bond, static distortions and other deviations from the regular periodicity of the lattice) and not by changes in the size of these regions. The established correspondence between the resistance to

deformation and the magnitude of type II distortions should not be taken as an indication of the major role of these distortions from the point of view of hardening. It can be assumed that the magnitude of these distortions (non-uniform elastic deformations of the micro-regions) is itself due to the properties of the crystallites of the given material. From this point of view the magnitude of type II distortions serves as an evaluation of the limit of elastic deformation of the micro-regions and can be considered as being a definite characteristic of the properties of the crystallites of a given substance. It is also possible that the observed type II distortions influence the resistance to deformation causing an increase in the degree of deorientation of the blocks. The experimental data obtained in the here described work on the relation between the fine structure and the strength of a material permit establishing certain relations governing these phenomena and leads to a number of new problems, the elucidation of which by further experiments is important from the point of view of

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understanding the nature of strength and hardening (work hardening) of metals and alloys.
There are 6 figures, 6 tables and 38 references, 29 of which are Soviet, 9 English.

ASSOCIATION: Institut metallovedeniya i fiziki metallov (TsNIIChM) (Institute of Metallography and Metal Physics TsNIIChM)

SUBMITTED: December 4, 1956

1. Iron alloys--Hardening 2. Iron alloys--Physical properties 3. Iron alloys--X-ray analysis 4. Iron alloys--Crystal structure

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SOV/126-6-1-12/33

AUTHORS: ~~Kurdyumov, G.~~ V., Maksimova, O. P., Nikonorova, A. I., Pavlenko, Z. D., and Yampol'skiy, A. M.

TITLE: Influence of Preliminary Plastic Deformation on the Martensitic Transformation in the Alloy Fe-Cr-Ni (Vliyaniye predvaritel'noy plasticheskoy deformatsii na martensitnoye prevrashcheniye v splave Fe-Cr-Ni)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 1, pp 95-105 (USSR)

ABSTRACT: The results are described of experiments carried out for elucidating the finer features of the influence of plastic deformation and subsequent annealing on the martensite transformation in Fe-Cr-Ni alloys of the type Kh18N8. The aim was to establish the activating effect of deformation in such an alloy and to verify the validity of the assumption of the activating influence of stresses on the martensitic transformation of deformed austenite. For this it was necessary to study the character of elimination of the after effects of deformation with gradually increasing annealing temperature; in view of the possible super-position of diffusion processes onto the processes of stress elimination during annealing,

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such investigations could not be effected on steel. If the assumption on the favourable influence of stresses on the martensitic transformation of deformed austenite would be correct, the effect of activation should be eliminated in the case of heating in the range of relatively low temperatures. Another aim of the described work was to study the influence of deformation on the isothermal martensitic transformation for the purpose of elucidating the characteristic features of the changes in the kinetics caused by the influence of the activating and/or the braking effects of deformation. Since the activating influence of deformation can only be detected in alloys with high elasticity values, it was decided to carry out the experiments on the alloy Kh18N8 (0.03% C, 18.10% Cr, 8.1% Ni) and the alloy Kh17N9 (0.05% C, 17.25% Cr, 9.16% Ni), both of which are similar in composition and as regards the martensitic point. On the alloy Kh18N8 the influence of deformation and subsequent heating for obtaining martensitic transformation during cooling was studied, whilst on the alloy Kh17N9 the influence of deformation on the isothermal

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martensitic transformation was studied. Investigations were carried out on flat 3.5 x 5.5 x 25.5 mm specimens which after manufacture were subjected to diffusion annealing at 1150°C for ten hours. The plastic deformation was effected by compression by means of a press at room temperature, at 100 and at 175°C. Deformation at 100 and 175°C was effected inside a special sleeve fitted with a heater winding ; as a medium for ensuring the temperature of 100°C boiling water was used, whilst deformation at 175°C was effected in glycerine. Evaluation of the change of the ability of the austenite to become transformed into martensite was effected by means of the thermo-magnetic method by plotting the curves of cooling to -196°C and subsequent heating to 20°C with a speed of 10°C/min. As the basic criterion of the stability of the austenite, the total transformation effect was chosen which was obtained as a result of cooling and heating. The change in the fine structure of the austenite during the plastic deformation and during the subsequent heating was investigated by the X-ray method

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by measuring the width of the line (311). As a characteristic of the state of the structure of the austenite (Type II stresses, dimensions of the blocks and coherent scattering), the magnitude of physical widening of the (311) austenite lines was chosen. In Fig.1 the transformation of the austenite into martensite during cooling to -196°C and subsequent heating to +20°C is graphed after various degrees of preliminary plastic deformation at room temperature for the alloy Kh18N8; in Fig.2 the same relation is graphed for the case of deformations taking place at 100°C and at 175°C. In Fig.3 the change of the total effect of martensitic transformation as a function of the degree of preliminary plastic deformation is graphed for various temperatures of preliminary deformation for the alloy Kh18N8. In Fig.4 the influence of the annealing temperature on the transformation of the deformed austenite during cooling to -196°C and heating to 20°C is graphed for various degrees of deformation at 100°C (alloy Kh18N8). In Fig.5

Card 4/8 the change of the widening of the line (311) of the

austenite, of the total effect of martensitic transformation (during cooling and during heating) and the change of the martensitic point are graphed as functions of the annealing temperature for specimens of the Kh18N8 alloy deformed by 10% at 100°C. In Fig.6 the temperature dependence of the initial speed and the total effect of isothermal martensitic transformation are graphed for non-deformed and deformed (8 and 17%) states for a deformation temperature of 100°C (alloy Kh17N9). It was found that, depending on the conditions of deformation and annealing, plastic deformation can have an activating or a braking effect on the martensitic transformation. Small degrees of deformation activate the transformation, i.e. widen the temperature range of the transformation, bring about an increase of the initial speed of the isothermal transformation and of the total quantity of the martensitic phase. Various changes in the fine crystalline structure of the austenite may lead either to easier formation of martensite nuclei during subsequent cooling or may impede their formation. For small degrees

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of plastic deformation those structural changes will occur to an increasing extent which bring about the formation of germinations. However, even at such degrees of deformation changes occur in the austenite which impede transformation. With increasing degree of deformation and also with increasing deformation temperature, the changes in the structure which bring about braking of the transformations increase in importance. The changes in the fine crystalline structure, which activate the transformation are eliminated at relatively low annealing temperatures at which the width of interference lines does not yet change, i.e. whilst there are still no important changes in the magnitude of the Type II distortions or in the dimensions of the areas of coherent scattering. Changes in the structure braking the formation of germinations are maintained thereby; elimination of these takes place only at higher temperatures corresponding to the region of decrease in the degree of blurring of the lines. It is not possible as yet to establish those details of the fine structure

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which favour the formation of martensite germinations and those which impede their formation. Comparison of the results relating to the influence of plastic deformation on the martensitic transformation in Fe-Ni-Mn and Fe-Cr-Ni systems leads to the conclusion that the intensity of the deformation caused changes of structural factors depends on the elastic-plastic properties of the austenite. The relation between the changes bringing about activation and braking of the martensitic transformations may differ depending not only on the degree of deformation but also on the elastic-plastic properties of the initial phase. As a result of this an unequal character of the effects of plastic deformation on the martensitic transformation

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Influence of Preliminary Plastic Deformation on the Martensitic Transformation in the Alloy Fe-Cr-Ni

was observed in various materials.
There are 6 figures and 11 references, 9 of which are Soviet, 1 German, 1 English.

ASSOCIATION: Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii (The Central Research Institute of Ferrous Metallurgy)

SUBMITTED: March 21, 1957

Card 8/8

1. Chromium-iron-nickel alloys--Transformations 2. Chromium-iron-nickel alloys--Deformation 3. Chromium-iron-nickel alloys--Heat treatment

Kul'tyumov, G.V.

18(4,7); 25(1) PHASE I BOOK EXPLOITATION SOV/2306

Akademiya nauk Ukrainskoy SSR. Institut metallofiziki

Voprosy fiziki metallov i metallovedeniya (Problems in the Physics of Metals and Metallography) Kiyev, Izdo-vo AN Ukrainskiy SSR, 1959. (Series: Its: Sbornik nauchnykh rabot, Nr 9) Errata slip inserted. 3,000 copies printed.

Ed. of Publishing House: V.L. Shkurko; Tech. Ed.: M.I. Yefimova; Editorial Board: V.N. Svechnikov, Academician, Academy of Sciences, Ukrainian SSR (Resp. Ed.); S.D. Gertsriken, Doctor of Physical and Mathematical Sciences; and I.Ya. Dekhtyar, Doctor of Technical Sciences.

PURPOSE: This collection of articles is intended for scientific workers, aspirants, and engineers in the fields of the physics of metals, metallography, and metallurgy. It may also be useful to students of advanced courses in metallurgical and physical faculties.

COVERAGE: This collection of articles deals with the following

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topics: effect of high-speed heating, heat treatment, deformations, and crystallization conditions on phase transformations, structures, and properties of metals and alloys; the effect of additional alloying components on volumetric and intercrystalline diffusion in alloys; and the effect of repeated quench hardening and radioactive and ultrasonic treatment on the physical properties of alloys. No personalities are mentioned. References follow several of the articles.

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VITMAN, F.F., prof., doktor fiz.-mat.nauk, otv.red.; IOFFE, A.F., akademik; red.; KURDYUMOV, G.V., akademik, red.; ZHURKOV, S.N., red.; KONSTANTINOV, B.P., red.; GLIKMAN, L.A., prof., doktor tekhn. nauk, red.; ZLATIN, N.A., doktor fiz.-mat.nauk, red.; STEPANOV, V.A., doktor tekhn.nauk, red.; FRIDMAN, Ya.B., prof., doktor tekhn.nauk, red.; IOFFE, B.S., kand.tekhn.nauk, red.; AVER'YANOV, V.I., red.izd-va; PEVZNER, R.S., tekhn.red.

[Some problems on the strength of solid bodies; collection of articles dedicated to the 80th birthday of N.N.Davidenkov, member of the Academy of Sciences of the Ukrainian S.S.R.] Nekotorye problemy prochnosti tverdogo tela; sbornik statei, posviashchennyi vos'midesiatiletiiu akademika AN USSR N.N.Davidenkova. Moskva, 1959. 386 p. (MIRA 12:6)

1. Akademiya nauk SSSR. 2. Chlen-korrespondent AN SSSR (for Zhurkov, Konstantinov).

(Strength of materials)

KURDYUMOV, G.V., akademik, obshchiy red.; NOVIKOV, I.I., obshchiy red.; LEVINSKIY, S.V., kand.med.nauk, red.; PRUSAKOV, V.N., kand.khim. nauk, red.; SEDOV, V.V., kand.med.nauk, red.; ANDREYENKO, Z.D., red.; MAZEL', Ye.I., tekhn.red.

[Proceedings of the Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958] Trudy Vtoroi mezhdunarodnoy konferentsii po mirnomu ispol'zovaniyu atomnoy energii, Zheneva, 1958. (Doklady sovetskikh uchenykh) Moskva, Izd-vo Glav.uprav. po ispol'zovaniui atomnoy energii pri Sovete Ministrov SSSR. Vol.6. [Production and application of isotopes] Poluchenie i primenenie izotopov. 1959. 388 p. (MIRA 12:11)

1. International Conference on the Peaceful Uses of Atomic Energy, 2d, Geneva, 1958. 2. Chlen-korrespondent AN SSSR (for Novikov). (Isotopes)

KURDYUMOV, G.V., akademik, red.; SINITSYN, V.I., red.; PANASENKOVA, Ye.I., red.; ~~MAZEL'~~, Ye.I., tekhn. red.

[Transactions. Selected reports by foreign scientists] Trudy. [Izbrannye doklady inostrannykh uchenykh] Moskva, Izd-vo Glav. uprav. po ispol'zovaniiu atomnoi energ. pri sovete Ministrov SSSR. Vol.10. [Production and use of isotopes] Poluchenie i primenenie izotopov. Pod obshchei red. G.V.Kurdiumova. 1959. 603 p. (MIRA 14:7)

1. Vtoraya mezhdunarodnaya konferentsiya po mirnomu ispol'zovaniyu atomnoy energii, Zheneva, 1958.

(Radioisotopes)

BIL'DZYUKEVICH, I.A.; KURDYUMOV, G.V.; KHANDROS, L.G.

Aging of certain iron-nickel-chromium base heat-resistant alloys. Issl.po zharopr.splav. 4:208-213 '59. (MIRA 13:5)

(Heat-resistant alloys)
(Iron-nickel-chromium alloys)

SOV/48-23-5-16/31

18(7)

AUTHORS: Zasimchuk, Ye. E., Kurdyumov, G. V., Larikov, L. N.

TITLE: The Influence of Alloy Elements on the Kinetics of Recrystallization of the Alloys With Nickel Basis (Vliyaniye legiruyushchikh elementov na kinetiku rekristallizatsii splavov na nikelevoy osnove)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 5, pp 615-619 (USSR)

ABSTRACT: The introduction to the present paper contains a table accurately describing the analyses of 27 alloys. Each of these alloys was converted to the monophase condition by thermal treatment and subsequently deformed at room temperature up to 80%. The samples were then annealed from 5 minutes to 10 hours in the temperature range of 280-900°C, and the state of recrystallization was investigated. The time was measured after which the primary center of recrystallization attained the magnitude of 10^{-3} cm at a given temperature. The results obtained from various measurements of the alloys in question are summarized in four diagrams; the logarithm of time τ, elapsing until the appearance and growing of the first recrystallization centers up to a magnitude of 10^{-3}cm,

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is plotted on the ordinate, and the value $T^{-1}.10^{3}$ is plotted on the abscissa, with T equalling the absolute annealing temperature. It holds $\tau = Ae^{RT}$, i.e. the measuring values of each individual alloy lie on a straight line, each alloy possessing its own characteristics. The energy activating recrystallization is determined from the velocity at which recrystallization takes place. These values are summarized in table 2 and are indicated in kcal/g-atom. Two further diagrams (Figs 5, 6) show the values of the activating energy, of the diffusion coefficient and of the modulus of elasticity of nickel alloys with chromium and molybdenum. Finally, conclusions are drawn from the results concerning the mobility of the atoms in the metal lattice, the concentration ratios in the boundaries of the growing recrystallization centers, and concerning the dependence of the surface tension on concentration. There are 6 figures, 2 tables, and 11 references, 9 of which are Soviet.

ASSOCIATION: Institut metallofiziki Akademii nauk USSR (Institute of Metal Physics of the Academy of Sciences, UkrSSR)

18(4),18(6)

AUTHORS: Kurdyumov, G. V., Academician, Kritskaya, V. K., Latayko, P. A., Osip'yan, Yu. A.

SOV/20-124-1-21/69

TITLE: On the Variation of the Forces of Interatomic Bond in a Single-phase Solid Solution Nickel-aluminum (Ob izmeneniyakh sil mezhatomnoy svyazi v odnofaznom tverdom rastvore nikel'-alyuminiy)

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 124, Nr 1, pp 76-78 (USSR)

ABSTRACT: Short reference is first made to earlier papers dealing with this subject. The castings of the nickel-aluminum alloy (8.3 atomic % Al) were annealed for 100 hours at 1,150°. The forging of the casting up to a cross section of 40 x 25 mm^2 began at 1,000° and was completed at a temperature of ~400-500°. Towards the end of the forging process the casting had already assumed a dark color. The forged work-pieces were then cold-drawn and from them samples of 100 mm length and 10 mm diameter were produced. On these samples, Young's modulus was determined by measurement of the resonance frequencies in the case of longitudinal oscillations of the rod at room temperature. The results obtained by these

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measurements are shown by a diagram for various initial alloy states. In the cold deformed and in the hardened state Young's modulus of the alloy is higher by 6 % than in the case of an annealed alloy. In order to convey the alloy from a state with a high modulus (state B) into one of a low modulus (state A) it is necessary to heat it up to temperatures of more than 600-700°, after which it is gradually cooled down. With heating up to 700-1,000°, Young's modulus gradually decreases. For the purpose of conveying the alloy from state A into state B it is sufficient to heat up to 300° with subsequent cooling in water. Already after heating up to 100° the modulus is noticeably increased. The state A does not change if cooling takes place slowly after heating to 300° or higher temperatures. These data make it possible to draw the conclusion that state B in a hardened alloy is not produced by undercooling of a steady state at high temperatures down to room temperature, but rather by such a transformation which occurs in the alloy only in the case of rapid cooling within the temperature interval of from 300° and room temperature. If the alloy is heated in state A up to

On the Variation of the Forces of Interatomic Bond in a Single-phase Solid Solution Nickel-aluminum SOV/20-124-1-21/69

300°, no essential changes occur in it either during heating or during aging. A change occurs only during rapid cooling. From the data discussed it further follows that the state B, which is produced by the rapid cooling of the alloy at a temperature below 300°, is a metastable state, which, in the case of a sufficiently high temperature, i.e. in the case of sufficient atomic mobility, may go over into the stable state A. At present, the nature of the alloys with high Young's modulus and the nature of the transition $A \rightarrow B$ is not yet known. The Debye X-ray pictures showed no difference between the crystal structures of the alloy in the states A and B. However, an essential difference was observed with respect to the microstructure of the alloy. Similar results were obtained also for a solid solution Ni - Cu (10.8 atom % Cu). There are 3 figures and 8 references, 5 of which are Soviet.

SUBMITTED: September 26, 1958

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~~18 (6), 18 (7)~~ 18.1250, 18.8200

66453

SOV/20-129-3-21/70

AUTHORS: Kritskaya, V. K., Kurdyumov, G. V.,
Academician, Osip'yan, Yu. A.

TITLE: On the Nature of the Variations of Young's Modulus in the Thermal Treatment of Single-phase Alloys on the Basis of Nickel

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 129, Nr 3, pp 550-552 (USSR)

ABSTRACT: The present paper investigates the dependence of the elastic modulus on thermal treatment carried out on samples of pure nickel (electrolytic nickel twice remelted in a vacuum) and on some solid solutions on a nickel basis (Ni + 10% Cu, Ni + 10% Co, Ni + 3.5% Mo). All these alloys were single-phased during the entire interval of the heat treatment. Both in the case of nickel and in all alloys investigated, the variations of the elastic modulus depend on the manner in which they are cooled down from high temperatures. The dependence of the elastic modulus on the temperature of thermal treatment is shown in a diagram. For nickel and for all solid solutions this dependence is qualitatively the same; it is similar to the dependence for the alloy Ni-Al. The differences between the values of the elastic modulus in the state A (with a low value of the elastic modulus) and the state B (with a high value of the elastic modulus) fluctuate between 5% for

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On the Nature of the Variations of Young's Modulus in the Thermal Treatment of Single-phase Alloys on the Basis of Nickel SOV/20-129-3-21/70

nickel and 12% for the alloy Ni - Co. A microstructure with many lines of slide is characteristic of the state B. A vertical displacement along the individual slide lines could be observed in the interference microscope. In the states A and B the investigated alloys have not only different values of the elastic modulus at room temperature, but also a different temperature dependence of the elastic modulus. For the annealed samples (state A) the temperature dependence of the elastic modulus has an anomalous character within the temperature interval of from room temperature to Curie point and is represented by means of a curve with a minimum. After quenching from a temperature that is higher than that of the total transition A → B, this anomaly of the elastic modulus vanishes, and in the state B it decreases in a monotonic manner with increasing temperature in the case of all alloys. After quenching and annealing, the difference between the values of the elastic modulus of nickel and its solid alloys is not determined by the difference in the strength of the binding forces, but by the influence exerted by the structure upon the mechanostrictional

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On the Nature of the Variations of Young's Modulus in the Thermal Treatment of Single-phase Alloys on the Basis of Nickel

66453

SOV/20-129-3-21/70

deformation of the ferromagnetic samples. The stresses leading to sliding in the case of rapid cooling are not due to a magnetic transformation during cooling. There are 4 figures and 4 references, 2 of which are Soviet.

SUBMITTED: August 3, 1959

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SOV/126---7-5-18/25

AUTHORS: Kurdyumov, G. V., Perkas, M. D. and Khandros, L. G.

TITLE: On the Role Played by Secondary Distortions in the Hardening of Metals (O roli iskazheniy vtorogo roda v uprochnenii metallov)

PERIODICAL: Fizika metallov i metallovedeniye, Vol 7, Nr 5, pp 747-751 (USSR)

ABSTRACT: In this paper binary Fe-Ni alloys containing 10, 25 and 28% nickel were investigated. The specimens were quenched from 1000 - 1050°C and subsequently tempered in the temperature range 100-550°C for 1 hour. The alloy containing 25% Ni was particularly thoroughly investigated. Hardening by quenching results in considerable secondary distortions ($\Delta a/a = 2.8 \times 10^{-4}$), the magnitude of which is close to that obtained in quenched steel containing 0.1% carbon (see Ref.9). The mosaic blocks are broken up to a size of 3×10^{-6} cm, and the ultimate tensile stress (σ_s) and hardness (H_V) are 80 kg/mm^2 and 265 VPN, respectively. Subsequent tempering at 300°C brings about a decrease in the secondary distortion (from 2.8×10^{-3} to 1.9×10^{-3}), but the remaining properties D, H_V, σ_s) remain practically unaltered (see Fig.1).

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SOV/126- -- 7-5-18/25

On the Role Played by Secondary Distortions in the Hardening of Metals.

Heating the specimens to higher temperatures leads to a further decrease in secondary distortions, and after tempering at 450°C $\Delta a/a$ is 0.3×10^{-3}. After such tempering the hardness and UTS remain practically unaltered, but the block size tends to increase. On heating the specimens to above 460°C the reverse transformation $\alpha \rightarrow \gamma$ takes place, and therefore after cooling to room temperature the microstructure contains the γ-phase together with the α-phase. This γ-phase possesses an increased resistance to transformation to martensite on subsequent cooling. In this connection a study of specimens of this alloy, tempered at temperatures above 460°C, was inexpedient. An attempt was made to attain at least some softening of the Fe + 25% Ni alloy by lengthy soaking of the specimens at a temperature somewhat lower than the beginning of the $\alpha \rightarrow \gamma$ transformation. The specimen was tempered at 440°C for 70 hours. The experimental results, however, have shown that the hardness and the widths of interference lines were close to those obtained after 1 hour's tempering at 450°C. In the Fe + 10% Ni alloy the reverse $\alpha \rightarrow \gamma$ transformation begins at approxi-

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mately 600°C. Therefore the quenched specimens can be tempered at least up to 550-580°C without running the risk of γ-phase formation. Data on the change of the fine structure and hardness of this alloy are shown in Fig.2. The extent of secondary distortions in a 10% Ni alloy changes little after tempering at 300°C, but a considerable decrease in secondary distortions occurs in a temperature range above 300°C. On tempering at above 450°C an increase in block size and some decrease in hardness is observed. For an Fe + 28% Ni alloy the nature of the change in hardness and fine structure on tempering was the same as in the case of the 25% Ni alloy. In order to elucidate the role played by secondary distortions in the hardening of alloyed iron the following experiments were also carried out with a quenched specimen of the 25% nickel alloy. The alloy hardened by quenching exhibited the following values: $\Delta a/a = 2.8 \times 10^{-3}$, $D = 2.8 \times 10^{-6}$ cm and $H_V = 260$ (see Fig.1). After tempering at 400°C for 1 hour the hardness and block size were practically unaltered and the secondary distortions had decreased to 0.7×10^{-3} (Fig.1). The specimen was then given a cold plastic deformation with a summary reduction in area of 50%. After deformation the secondary distortions had again increased from 0.7×10^{-3}

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to 2.0×10^{-3}. The block size and hardness were 2.9×10^{-6} cm and 270 H_V respectively; i.e. they had remained at the same level (see Table p.750). The other specimens of the same alloy were tempered at 450°C after quenching. After tempering, $\Delta a/a$ was 0.3×10^{-3}, D - 3.5×10^{-6} and H_V - 265. As a result of a subsequent cold plastic deformation with a summary reduction in area of 60% the secondary distortions had increased to 2.9×10^{-3} whilst block size and hardness had again changed comparatively little (D = 2.8×10^{-6} cm and H_V = 285). Thus the available data on the relationship between hardness and fine crystal structure of metals and solid solutions enables one to conclude that the most important crystal structure factors determining the hardness of metals and one-phase alloys are, breaking down of the grain size to fragments of 10^{-3}-10^{-4} cm with a considerable disorientation of the lattice between the fragments, and the formation, within the fragment, of a sub-microscopic block structure.

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SOV/126---7-5-18/25

On the Role Played by Secondary Distortions in the Hardening of Metals

There are 2 figures, 1 table and 9 Soviet references.

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChM, Institut metallofiziki AN USSR (Institute of Metallurgy and Physics of Metals TsNIIChM, Institute of Metal Physics, Ac. Sc., Ukrainian SSR)

SUBMITTED: January 22, 1959

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SOV/126-7-5-29/...

AUTHORS: Kardonskiy, V. M., Kurdyumov, G.V. and Perkas, M. D.

TITLE: Influence of the Properties of Crystals on the Strength of Metals in the Hardened Condition (O vliyanii svoystv kristallov na prochnost' metallov v uprochnennom sostoyanii)

PERIODICAL: Fizika metallov i metallovedeniye, Vol 7, Nr 5, pp 752-756 (USSR)

ABSTRACT: Kurdyumov et alii (Ref.2) have shown that there exists a linear relationship between the degree of secondary distortion and the hardness of martensite in quenched low C steels (see Fig.1). Golubkov et alii (Ref.3) have shown that there exists a direct relationship between the degree of secondary distortion and the hardness of alloyed iron after cold plastic deformation (see Fig.2). Using results obtained by the latter authors a diagram has been constructed (Fig.3) showing the dependence of the degree of secondary distortion, arising as a result of cold plastic deformation, on the hardness of the original annealed alloy iron. From the above diagram it can be seen that the absolute hardness of hardened alloys is determined not only by the fine grain structure but also by

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SOV/126--7-5-19/25

Influence of the Properties of Crystals on the Strength of Metals in the Hardened Condition

the properties of the crystals of the original metals as annealed. These properties also determine the elastic limit of micro-regions, $\Delta a/a$, in the hardened state. For a further study of the above conclusions the authors investigated alloys in which the properties of solid solution crystals strongly depended on the concentration of the dissolved elements. Among the iron alloys the most suitable ones for investigation are iron-silicon alloys with a silicon content up to the limiting solid solubility in α-iron. The chemical composition of the original iron and its alloys with silicon is given in Table 1. The methods used for the study were the same as those employed by Golubkov et alii (Ref.3). In Table 2 the results of hardness, UTS and temporary resistance measurements of annealed alloys are shown. In Fig.3 curves are plotted which express the dependence of hardness on the degree of plastic deformation. The relationship between the strength properties and the fine structure in the hardened state were studied in specimens of alloys which had been deformed at identical loads (85 tons). The degree of deformation was found to vary from 68% for iron free from silicon to 48%

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SOV/126- - -7-5-19/25

Influence of the Properties of Crystals on the Strength of Metals in the Hardened Condition

for an alloy containing 9.4% Si. In accordance with the results shown in Fig.4 the hardening of all the alloys must be close to "saturation". The results of the study of the specimens are shown in Fig.5. These show that the increase in hardness as a result of cold deformation is not related to the magnitude of secondary distortions arising during deformation as it is practically independent of the Si concentration, whilst $\Delta a/a$ increases by nearly twice.

However, $\Delta a/a$ increases proportionately to the hardness of the annealed material. Thus the results obtained are in agreement with the idea that the secondary distortions are not alone responsible for the hardness arising from the cold deformation and martensite transformation, but reflect the properties of crystals of a given material, characterizing the "limit" of the elastic deformation of micro-regions. These properties determine the level of the strength which can be attained as a result of changes in the internal microscopic and sub-microscopic grain structure in the hardening process.

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SOV/126- -- -7-5-19/25

Influence of the Properties of Crystals on the Strength of Metals in the Hardened Condition

There are 5 figures, 2 tables and 7 references, of which 6 are Soviet and 1 English.

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Metallurgy and Metal Physics TsNIIChM)

SUBMITTED: January 22, 1959

Card 4/4

KURDYUMOV, Georgiy Vyacheslavovich; RABINOVICH, A.M., red.; LEVIT, Ye.I., red.izd-va; DOBUZHINSKAYA, L.V., tekhn.red.

[Phenomena of the hardening and tempering of steel] IAvleniia zakalki i otpuska stali. Moskva, Gos.nauchno-tekhn.izd-vo lit-ry po chernoi i tsvetnoi metallurgii, 1960. 63 p. (MIRA 14:2)

(Steel--Heat treatment)

S/129/60/000/010/004/009
E193/E483

AUTHOR: Kurdyumov, G.V., Member of the Academy of Sciences USSR

TITLE: The Nature of the Hardened State of Metals

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, No.10, pp.22-30

TEXT: The article is the text of a lecture delivered at the All Union Conference on Theoretical Problems of Metal Treatment, held in November 1958. Based on previously published results of various investigations, conducted by the present author and other workers, the effect of heat and mechanical treatment on the strength of metals and alloys is discussed. It is pointed out that the increase in strength of pure metals or single-phase alloys due to cold plastic deformation or martensitic transformation is always associated with the fragmentation of grains, misalignment of the sub-grains thus formed and the formation (within the sub-grains) of blocks which constitute sub-microscopic regions of coherent scattering of X-rays. In addition, the actual strength of a given material will depend on the properties of the crystals of which the material consists, such as the yield point in the annealed condition and the magnitude of the distortion of the

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S/129/60/000/010/004/009
E193/E483

The Nature of the Hardened State of Metals

second type (elastic deformation of microscopic domains), caused by heavy plastic deformation or transformations of the martensitic type. Thus, the first necessary condition for increasing the strengths of a metal or alloy is the attainment of uniformly distributed microscopic and sub-microscopic structural heterogeneity. Further increase in strength, with the aid of mechanical or heat treatment, depends on the extent to which the degree of dispersion of this structural heterogeneity can be increased and on the possibility of formation (in the micro-regions) of new phases with higher resistance to deformation. The possibilities offered in this respect of cold plastic deformation are limited by the maximum amount of deformation a metal can stand without fracture or without formation of micro-cracks or their nuclei. To some extent this difficulty can be overcome by deforming materials under the conditions of hydrostatic pressure. Finally, metals characterized by strength approaching the theoretical value can be obtained by preparation of single, defect-free crystals, the advantage of this method being that it yields material in a stable condition as opposed to thermally or

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E193/E483

The Nature of the Hardened State of Metals

mechanically treated metal which retains its strength only within a certain temperature range. There are 6 figures, 1 table and 10 Soviet references.

ASSOCIATION: TsNIIChM

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84684

21 6200 1138, 1403, 2308 only

S/020/60/134/004/008/023
B019/B067

AUTHORS: Batenin, I. V., Il'ina, V. A., Kritskaya, V. K., Kurdyumov, G. V., Academician, and Sharov, B. V.

TITLE: Effect of Neutron Irradiation 19 on the Crystalline 8 Fine Structure and the Properties of Metals and Alloys

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 134, No. 4, pp. 802 - 805

X

TEXT: The authors studied the broadening of X-ray interference lines of iron, iron alloys, and copper by neutron irradiation (10^{20} - 10^{21} n/cm^2). Prior to the experiments the samples were annealed at 600 - 650°C. Fig. 1 shows the changes of the (220)- and (400) interference lines of iron and copper due to neutron irradiation, Fig. 2 shows two X-ray photographs of copper (before and after irradiation). In Table 1 the changes in the widths of the interference lines are summarized:

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Effect of Neutron Irradiation on the Crystalline Fine Structure and the Properties of Metals and Alloys

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B019/B067

Table 1

Material	Indices of the reflecting surfaces	Line widths		Distortions of II kind $\Delta a/a.10^3$	Block dimensions $D \cdot 10^6$ cm
		before irrad.	after irrad.		
Fe	(110)	5.0	5.6	0.65	8
Cu	(220)	7.3	9.4		
	(200)	5.9	7.0		
	(400)	11.0	15.6	1	5

In Table 2 the changes in microhardness are given. The values are between 26 and 66%, according to material and irradiation intensity. Since the changes in the interference lines are the same as in cold-forming, the authors conclude that neutron irradiation leads to a reduction of the regions of coherent scattering and to microtensions, as is the case in cold-forming. The solidification of the material is connected with the change in the crystal properties in the microregions. Here, the resistance to dislocations in the lattice is increased. The authors conclude there-

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Effect of Neutron Irradiation on the Crystalline Fine Structure and the Properties of Metals and Alloys

S/020/60/134/004/008/023
B019/B067

from that the increase in microhardness is summed by irradiation and cold-forming. This exactly applies for iron, as is shown by the diagrams in Fig. 2. For the anomalous behavior of an iron tungsten alloy (6% W) it is assumed that irradiation not only causes defects of the type "external atomic vacancies" as is usually the case but also a change in the distribution of the tungsten atoms in the direction of the thermodynamically more stable state. There are 3 figures, 2 tables, and 6 Soviet references.

X

ASSOCIATION: Institut teoreticheskoy i eksperimental'noy fiziki Akademii nauk SSSR (Institute of Theoretical and Experimental Physics of the Academy of Sciences USSR). Institut metallovedeniya i fiziki metallov Tsentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii im. I. P. Bardina (Institute of Metallography and Metal Physics of the Central Scientific Research Institute of Nonferrous Metallurgy imeni I. P. Bardin)

SUBMITTED: June 29, 1960

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26795
S/129/61/000/009/003/006
18.8200 E193/E380

AUTHORS: Kurdyumov, G.V., Academician of the AS USSR and Perkas, M.D., Candidate of Technical Sciences

TITLE: On the Effect of Crystal Properties and Grain Substructure on the Strength of Metals

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1961, No. 9, pp. 33 - 43

TEXT: An analysis is presented of experimental results, published in recent years both in the Soviet Union and abroad, with the object of elucidating the basic structural factors determining the strength of metals. It is shown that although distortions of the second type (lattice distortions) hardly affect the resistance of metal to deformation, they characterise the relative properties of the crystals of a given substance which, in turn, affect resistance to deformation. The effect of various mechanical and thermal treatments on hardness, the dimensions of blocks and the magnitude of $\Delta a/a$ in Fe-Si alloys are discussed as well as the temperature-dependence of the yield point and UTS of preliminarily quenched and annealed

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APPROVED FOR RELEASE: 06/19/2000 CIA-RDP86-00513R000927710005-0"

26795
S/129/61/000/009/003/006
On the Effect of Crystals E193/E380

specimens
25% Ni-Fe alloy/ the temperature-dependence of hardness and the width of interference lines of Fe and Ni, the effect of cold work on hardness and dimensions of the regions of coherent scattering and the effect of neutron bombardment on microhardness and yield point of metals. Several conclusions are reached:
1) the resistance of metals to deformation is determined mainly by the properties of crystals (that is, by the resistance to movement of dislocations in the interior of sub-boundary-free regions) and by the grain sub-structure (that is, by the dimensions of the sub-microscopic domains, the existence of sub-boundaries, degree of misorientation of adjacent regions, etc.). The effect of both these factors is additive.
2) The properties of the crystals can be altered by the addition of alloying elements, by creating distortions in the interior of sub-microscopic domains (for example, by neutron bombardment or by quenching of pure metals), and by varying the temperature. A comparative assessment of the properties of the crystals can be made by measuring the yield point or hardness of annealed material, or by determining the magnitude of lattice distortions

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On the Effect of Crystals S/129/61/000/009/003/006
E193/E380

in cold-worked specimens.
3) Alloying can bring about a change in the temperature-dependence of both sub-structure stability and crystal properties. If alloying is to increase the high-temperature strength of a metal, both factors must be changed in the favourable direction: thermal stability of the sub-structure must be increased and the rate at which the resistance of crystals to elementary acts of plastic deformation decreases with rising temperature must be reduced.
There are 10 figures and 24 references: 16 Soviet and 8 non-Soviet. The four latest English-language references quoted are: Ref. 12 - W.G. Jonston, J.J. Gilman - "Journ. Appl. Phys.", v.70, No. 2, 1959; Ref. 19 - A. Cottrell - Trans. of the Metallurg. Soc AIME, V. 212, 1958; Ref. 20 - D.F. Stein, J.R. Low - Journ. Appl. Phys., Vol.31, No. 2, 1960; Ref. 24 - W.C. Jouston, J.J. Climan - Journ. Appl. Physics, V.31, No. 4, 1960.

ASSOCIATION: TsNIIChM

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KURDYUMOV, G.V.; LOBODYUK, V.A.; KHANDROS, L.G.

Form of martensite crystals and the orientation of the interphase boundaries in the alloy Cu-Al-Ni. Kristallografiia 6 no.2:210-217 Mr-Ap '61. (MIRA 14:9)

1. Institut metallofiziki AN USSR.
(Martensite crystals) (Phase rule and equilibrium)
(Copper-aluminum-nickel alloys)

20215

18 1510

S/126/61/011/002/014/025
E193/E483

AUTHORS: Arbuzova, I.A., Kurdyumov, G.V. and Khandros, L.G.

TITLE: Growth of Elastic Crystals of the Martensitic γ'-Phase Under the Action of Applied Stress

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.2, pp.272-280

TEXT: When a martensitic transformation takes place in an alloy, considerable stresses of either side are set up in the matrix by the first-to-form martensite grains. In some regions these internal stresses may bring about nucleation and growth of new martensite grains, in others they may have an opposite effect. The object of the investigation described in the present paper, was to establish whether the same effect can be produced by externally applied stresses. The experiments were carried out on a Cu-base alloy, containing 14.44 wt.% Al and 4.75 wt.% Ni, in which the martensitic transformation $\beta_1 \rightarrow \gamma'$ begins at app 30°C. To facilitate visual examination of the relief patterns, the experimental specimens (measuring 0.7 x 2.5 x 12 mm), preliminarily quenched from 900°C, were heated to 70°C and polished at this temperature. After cooling to room temperature, several martensite

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needles appeared on the specimen surface but the bulk of the alloy remained untransformed. The effect of the application of external stress was studied with the aid of a specially designed apparatus, schematically illustrated in Fig.1. The apparatus consists of a vacuum chamber (4) which incorporates a rod (5), mounted on bellows and used to heat or cool the test piece (7), and a pair of grips (6) for fastening the test piece. (The temperature of the rod is changed with the aid of a thermos flask, containing a hot liquid or liquid nitrogen.) One of the grips is rigidly attached to the body of the vacuum chamber, the other being joined to a connecting rod which enters the vacuum chamber through an opening, provided with a rubber seal. A dial gauge indicator (8) for measuring the strain is rigidly attached to the vacuum chamber, its plunger pressing against a regulating spring, attached to the connecting rod, the latter being joined to a ring dynamometer (11). Stress is applied by turning the handle (9) and its magnitude is shown on an indicator (12), calibrated in kg/mm2. The vacuum chamber is closed by a lid (13), provided with a window (14) through which the test piece can be observed through a microscope (2), or photographed with the aid of a photo-camera (1). In one

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Growth of Elastic ...

series of experiments, a test piece was subjected to tensile or compressive stresses and the resultant movement of the phase boundaries was studied directly by visual examination of the polished specimen surface. In other experiments, the test pieces were cooled from above the martensitic transformation temperature and the resultant variation of the relative quantities of the β_1 and γ' phases was assessed. The results indicated that growth, or a decrease in size, of a martensitic phase crystal can be caused either by the variation of temperature or by the application of external stress. Although the growth of a martensitic crystal can be induced by both tensile and compressive stresses, it is only the favourably oriented grains that increase in size in either case. When the direction of the applied stress is changed, crystals with a certain orientation of the habit planes disappear and grains with a different orientation are formed in their place. The movement of the phase boundaries takes place both on the application and on removal of the external load. When, however, martensitic grains are formed under conditions such that only one boundary intersects a whole single crystal, no movement of the boundary takes place on removal of the applied load. The behaviour of crystals with a

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single boundary under the action of applied stress is similar to that induced by temperature variation and can be compared to the behaviour of elastic twins, intersecting a single crystal. There are 4 figures and 6 Soviet references.

ASSOCIATION: Institut metallofiziki AN UkrSSR
(Institute of Physics of Metals AS UkrSSR)

SUBMITTED: June 2, 1960

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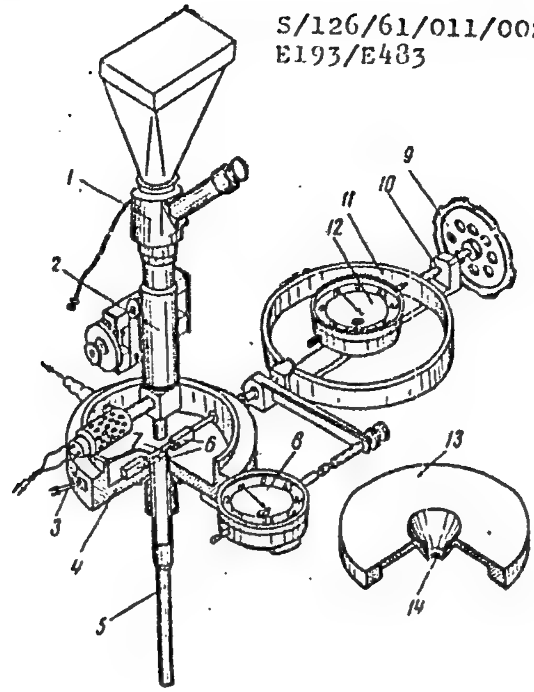
Growth of Elastic ...

Fig. 1



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21366
S/126/61/011/004/016/023
E193/E483

AUTHORS: Kardonskiy, V.M., Kurdyumov, V.G., Kurdyumov, G.V. and Perkas, M.D.

TITLE: The Effect of the Grain Substructure and Crystal Properties on Strength. I. The Fe-Ni and Fe-Si Alloys

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.4, pp.609-614

TEXT: The object of the investigation described in the present paper was to study the effect of the thermally induced variation of the properties of crystals on strength of metals in the hard condition and on the magnitude of the elastic deformation of micro-domains (distortions of the second type). The experimental work was carried out on two Fe-base alloys, one containing 25% Ni and the other 1.15% Si. (The Ni-bearing alloy was chosen for this purpose because of its specific characteristic, consisting in that annealing of this alloy at 450°C brings about a complete removal of the distortions of the second type without significantly affecting the size of the regions of coherent scattering.) The Fe-Ni alloy was hardened by quenching, the Fe-Si alloy by cold rolling to 50% reduction in thickness. In addition to the determination

APPROVED FOR RELEASE: 06/19/2000 CIA-RDP86-00513R000927710005-0"

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The Effect of the Grain ... S/126/61/011/004/016/023
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(by X-ray diffraction analysis) of the magnitude of distortions of the second type, $\Delta a/a$, and the size D of the regions of coherent scattering, the yield point (σ_s), U.T.S. (σ_B) and Vickers hardness number (HV) of both hardened and partially annealed alloys were measured, and the temperature-dependence of these properties was determined for both hardened and fully annealed specimens. The results of the first series of experiments, carried out on preliminarily hardened Fe-Ni alloy, are reproduced in Fig.1, where HV, σ_s (kg/mm^2), D (10^{-6}, cm) and $\Delta a/a$ (10^{-3}) are plotted against the annealing temperature (°C); in addition, the diagram shows the temperature-dependence of HV and σ_s (curves, marked HV(t) and σ_s(t), respectively). It will be seen that the temperature dependence of σ_s and HV is quite different from the relationship between these properties (measured at 20°C) and the annealing temperature. Thus, σ_s measured at 450°C is 25 kg/mm^2 lower than σ_s measured at 20°C after annealing at 450°C, the corresponding difference for HV being 90 units. On the other hand, the temperature-dependence of σ_s and HV is almost identical with the relationship between $\Delta a/a$ and the annealing temperature. The fact that σ_s of preliminarily

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hardened specimens is practically constant after annealing at various temperatures indicates that σ_s, measured under these conditions, reflects mainly the character of the variation of the grain substructure during heating; in fact, D of specimens, annealed at various temperatures, also remains practically constant (see Fig.1). In the next series of experiments, preliminarily hardened specimens of the Fe-Ni alloy were annealed at 430°C to attain almost complete removal of the distortions of the second type, and then the temperature dependence of σ_s of these specimens was determined. This was found to be identical with that of fully hardened alloy, whereby the view was confirmed that the resistance of an alloy to deformation is not increased by the presence of distortions of the second type. Owing to the comparatively low temperature at which the reverse $\alpha \rightarrow \gamma$ transformation takes place in the Fe-Ni alloy, it was not possible to use this material to study the relationship between $\Delta a/a$ and the temperature dependence of annealed specimens. For this purpose the Fe-Si alloy was more suitable. The results of experiments carried out on this material are reproduced in Fig.4 which shows: temperature dependence of HV of cold-rolled alloy

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(curve HV(t), white triangles); temperature dependence of HV of specimens annealed at 750°C (curve HV(t), white squares); variation of HV of preliminarily hardened specimens after annealing at various temperatures (curve HV, white triangles); variation of D (dots) and $\Delta a/a$ (white triangles) after annealing at various temperatures. The temperature dependence of HV of the annealed specimens reflected the decrease in the resistance of the alloy to deformation due to the variation of the properties of crystals with rising temperature; since the specimens were annealed at 700°C, their grain substructure should remain unchanged during subsequent heating and should not affect the variation of HV. In the case of the cold-rolled specimens, whose HV was measured at room temperature after annealing at various temperatures, the variation of HV reflected only the changes in the micro- and sub-microscopic structure of the grains, brought about by heating to progressively higher temperatures. This means that in the temperature dependence of HV of cold-rolled material, HV at each temperature should be determined by the changes in both the grain substructure and the crystal properties that have taken place as a result of heating to this
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temperature. Starting from these considerations, the present authors constructed a "theoretical" curve, illustrating the temperature dependence of HV of cold-worked alloy, simply by adding (for each temperature) the decrease in HV due to the change in the crystal properties (found from the experimentally determined temperature dependence of annealed specimens) to that due to the variation of the grain substructure (found from the experimentally determined variation of HV of cold-worked specimens after annealing at various temperatures). The results plotted in Fig.4 (black triangles) were in good agreement with the experimental curve (white triangles). The results of the present investigation confirmed the view that strength (resistance to deformation) of a hardened material is determined by two factors: (1) the properties of the crystals (resistance to the movement of dislocations in the crystal regions, free from sub-boundaries) and (2) the substructure of the crystals (size of the sub-micro-regions, presence of sub-boundaries, degree of misorientation of the mosaic blocks). There are 5 figures and 9 Soviet references.

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The Effect of the Grain ...

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Science of Metals and Physics of Metals, TsNIIChM)

SUBMITTED: August 26, 1960

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S/126/61/011/004/017/023
E193/E483

188200 1418,1555

AUTHORS: Kardonskiy, V.M., Kurdyumov, G.V. and Perkas, M.D.

TITLE: The Effect of the Grain Substructure and Crystal Properties on Strength. II. Iron and Nickel

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.4, pp.615-619

TEXT: The object of the present investigation was to obtain additional experimental evidence on the relative part played in increasing the strength of metals by the variation of the crystal structure and by the changes in other properties of crystals. Nickel and iron were chosen as the experimental materials because of the different temperature dependence of their yield points below 20°C. In the first series of experiments, Vickers hardness HV and the width B of the (220) lines of iron were measured after various thermal and mechanical treatments. After 1 h annealing at 750°C, HV and B (measured at 20°C) were 65 kg/mm^2 and 11×10^{-3} radians respectively; on lowering the temperature to -180°C, HV increased to 185, but B remained practically unchanged. The specimen was then deformed plastically (30% compression) at -180°C, after which HV (measured at this

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temperature) was 220 kg/mm^2, and B increased to 31 x 10^{-3} radians. After heating to 20°C, B of this specimen decreased to 22 x 10^{-3} radians and HV to 98 kg/mm^2. When the specimen was cooled again to -180°C, hardness increased back to 220 kg/mm^2 but B remained unchanged. These results indicated that an increase in hardness (strength) can be caused either by the variation of the crystal properties alone (the increase in HV after cooling to -180°C was not accompanied by any change of B) or by the change of the grain substructure (the increase in HV due to plastic deformation was accompanied by an increase in B). In this connection, the authors point out that when an annealed Fe specimen was compressed at 20°C to 30% deformation, its HV increased from 63 to 85 kg/mm^2 and B from 11 x 10^{-3} to 19 x 10^{-3} radians; after cooling to -180°C, HV increased to 200 kg/mm^2. The relatively higher increase in HV after plastic deformation at -180°C (see above) was attributed to a higher degree of dispersion of the grain substructure, formed at this temperature. A series of similar experiments was conducted on nickel. It was found that, in contrast to iron, HV of annealed Ni cooled to -180°C increased only by ΔHV = 15 kg/mm^2; plastic

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substructure playing a relatively small part. In the case of Ni, the part played by the variation of the crystal properties is small in comparison with that played by the formation of submicroscopically heterogeneous structure. In both cases, however, the effect of these two factors is additive. There are 5 figures and 7 references: 5 Soviet and 2 non-Soviet.

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Science of Metals and Physics of Metals, TsNIIChM)

SUBMITTED: August 26, 1960

Card 4/5

S/126/61/012/006/013/023
E111/E435

AUTHORS: Kurdyumov, G.V., Nesterenko, Ye.G.

TITLE: Micro-stresses and coherent-scattering regions in martensite crystals

PERIODICAL: Fizika metallov i metallovedeniye, v.12, no.6, 1961. 883-890

TEXT: Micro-stresses as well as the small size of regions of coherent scattering play a part in the broadening and blurring of X-ray interference lines from martensite in hardened steel. If martensite crystals are isolated (by electrolytic solution) the micro-stresses produced by elastic deformation disappear. The object of the present work was to obtain more precise knowledge of the nature and causes of micro-stresses arising on quenching steel. Types У-12 (U-12) and У-10А (U-10A) steels were used. From the broadening and decrease in intensity of the interference lines of martensite, the crystal-lattice disturbances and the size of the coherent X-ray scattering regions were determined by means of previously described techniques. The following specimens were studied: martensite isolated from hardened pieces of U-10A and

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Micro-stresses and coherent- ...

U-12A steels; hardened filings of U-12A steel; hardened 1.2 mm diameter specimens of U-12A steel; hardened 4 x 10 x 10 mm specimens of U-12A steel. Before the X-ray pattern was obtained a 0.2 mm thick layer was etched off all the specimens except filings (from which very little was etched off): this was found to give carbon contents in the saturated solid solution (martensite) equal to those analysed in the steel. The results showed that the value of type II disturbances ($\delta a/a$) in martensite crystals of hardened steel depends on the dimensions of the specimen hardened; it is a basic factor that there is no difference between the values for the very fine filings and those for the 1.2 mm diameter cylinder. This indicates that the disturbances are due to deformation produced by the formation of the martensite crystals and deformation produced by thermal stresses. The hardness measurements of the hardened cylinders and pieces of U-12A steel was found to be almost the same; since their type II disturbance values are different, this means that the high hardness of martensite in hardened steel is not due to the presence of type II disturbances. The authors stress that for martensite isolated

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Micro-stresses and coherent- ... S/126/61/012/006/013/023
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from U-12A the line broadening is due only to the small block size; this was found to be 2.6×10^{-6} cm for U-10 steel and this is in good agreement with published results (Ref.3: Arbuzov M.P., Lysak L.I., Nesterenko Ye.G. DAN SSSR, v.90, 1953, 3). The size of the coherent scattering region was found to be independent of the method used to determine them. The uniform deformation region in martensite crystals is considerably larger than in plastically deformed metals, confirming the conclusion jointly published by one of the authors (Nesterenko) and others (Ref.3) that martensite crystals in a piece of hardened steel are elastically deformed by forces external to them. For isolated martensite the situation is entirely different. Static disturbances can produce changes in the intensity of X-ray interference without appreciable width change, but special experiments are needed to check whether this effect could be responsible for the observed relationships. Study of the effect of linear dimensions of specimens on static disturbances showed that for martensite in hardened steel they are due wholly to the presence of interstitial carbon atoms in the alpha-iron lattice.

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Micro-stresses and coherent- ... S/126/61/012/006/013/023
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There are 8 figures, 5 tables and 11 references: 8 Soviet-bloc and 3 non-Soviet-bloc. The three references to English language publications read as follows: Ref.4: Stokes A.R. Proc. Phys. Soc. v.61, 1948, 382; Ref.5: Warren B.E., Averbach B.L. J. Appl. Phys., v.23, 1952, 497; v.21, 1950, 595; Ref.8: McKechan M., Warren B.E. J. Appl. Phys., v.24, 1953, 52.

ASSOCIATION: Institut metallofiziki AN UkrSSR
(Institute of Physics of Metals AS UkrSSR)

SUBMITTED: May 22, 1961

Card 4/4

TUMANOV, A.T., zasluzhennyy deyatel' nauki i tekhniki RSFSR; DAVIDENKOV, V.V., akademik; SERENSEN, S.V., akademik; KURDYUMOV, G.V., akademik; BOCHVAR, A.A., akademik; KISHKIN, S.T.; ZAYMOVSKIY, A.S.; SHCHAPOV, N.P., prof.; KUDRYAVTSEV, I.V., prof.; VITMAN, F.F., prof.; KISHKINA, S.I., prof.

IAkov Borisovich Fridman; on the fiftieth anniversary of his birth. Zav.lab. 27 no.7:919-920 '61. (MIRA 14:7)

1. Akademiya nauk USSR (for Davidenkov, Serensen). 2. Chleny-korrespondenty Akademii nauk SSSR (for Kishkin, Zaymovskiy).
(Fridman, IAkov Borisovich, 1911-)

KURDYUMOV, G. V.

9C

PHASE I BOOK EXPLOITATION SOV/6176

Konobeyevskiy, S. T., Corresponding Member, Academy of Sciences USSR, Resp. Ed.

Deystviye yadernykh izlucheniy na materialy (The Effect of Nuclear Radiation on Materials). Moscow, Izd-vo AN SSSR, 1962. 383 p. Errata slip inserted. 4000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Otdeleniye tekhnicheskikh nauk; Otdeleniye fiziko-matematicheskikh nauk.

Resp. Ed.: S. T. Konobeyevskiy; Deputy Resp. Ed.: S. A. Adasinskiy; Editorial Board: P. L. Gruzin, G. V. Kurdyumov, B. M. Levitskiy, V. S. Lyashenko (Deceased), Yu. A. Martynyuk, Yu. I. Pokrovskiy, and N. F. Pravdyuk; Ed. of Publishing House: M. G. Makarenko; Tech. Eds: T. V. Polyakova and I. N. Dorokhina.

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9C

The Effect of Nuclear Radiation (Cont.) SOV/6176

PURPOSE: This book is intended for personnel concerned with nuclear materials.

COVERAGE: This is a collection of papers presented at the Moscow Conference on the Effect of Nuclear Radiation on Materials, held December 6-10, 1960. The material reflects certain trends in the work being conducted in the Soviet scientific research orginization. Some of the papers are devoted to the experimental study of the effect of neutron irradiation on reactor materials (steel, ferrous alloys, molybdenum, avial, graphite, and nichromes). Others deal with the theory of neutron irradiation effects (physico-chemical transformations, relaxation of internal stresses, internal friction) and changes in the structure and properties of various crystals. Special attention is given to the effect of intense γ-radiation on the electrical, magnetic, and optical properties of metals, dielectrics, and semiconductors.

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S/180/62/000/003/010/016
E111/E152

AUTHORS: Zasimchuk, Ye.E., Kurdyumov, G.V., and Larikov, L.N. (Kiyev)

TITLE: Influence of aluminium and titanium on the linear rate of growth of recrystallization nuclei in deformed nickel and nichrome

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Metallurgiya i toplivo, no.3, 1962, 85-87

TEXT: The effect of 0-16.6 % at. Al and 0-12.5 % at. Ti, present separately, on the linear rate of growth of recrystallization nuclei in 80% deformed nickel and nichrome specimens, was studied. Recrystallization annealing was effected at 200-800 °C with holding time of 5 minutes to 10 hours. The measure of recrystallization rate was the time required for the formation and growth of the first nuclei to a certain size. This time was determined by the X-ray method using Cr radiation (Ref.5: Zasimchuk, Ye.E., Larikov, L.N. DAN URSR, no.1, 1959, 42).

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The rate of growth was found to follow the usual exponential law. The term, characterising the temperature dependence of the rate, rises from 48 ± 2 kcal/g.atom for pure nickel to 82 ± 3 when 1 % at. Al, and to 88 ± 3 when 1 % at. Ti are added. Further additions of Al or Ti have no effect. The mechanism causing the lowering of the linear rate of growth of the recrystallization centres on passing into the two-phase region was attributed to the effect of the precipitation of the dispersed particles of the second phase and was studied by one of the authors (Ref.12: Larikov, L.N. Izd. AN USSR, no.11, 1960, 61).
There are 2 figures and 1 table.

SUBMITTED: March 28, 1961

S/717/62/000/007/001/010
D207/D301

AUTHORS: Kardonskiy, V.M., Kurdyumov, G.V., Member of the Academy of Sciences, USSR, and Perkas, M.D., Candidate of Technical Sciences

TITLE: Relationship between changes of the fine structure and the resistance to plastic deformation of metals and alloys after hardening

SOURCE: Dnepropetrovsk. Institut metallovedeniya i fiziki metallov. Problemy metallovedeniya i fiziki metallov, no. 7, Moscow, 1962, 7 - 33

TEXT: A review is given of the recent work on iron and its solid solutions carried out at the Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Metallography and Physics of Metals TsNIIChM). The fine structure is defined as microscopic and submicroscopic structural inhomogeneities in crystal grains. Such structure was investigated and related to changes in mechanical properties. The authors discuss work on cold plastic deformation, the effect of alloying, the
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Relationship between changes of the ... S/717/62/000/007/001/010
D207/D301

role of elastic microstresses ('stresses of the second kind'), the relationship between annealing and elastic microstresses and the effects of heating. It was found that the principal cause of the increase of the resistance to plastic deformation, produced by cold working and other treatments, is due to the appearance of submicroscopic structure in individual crystal grains. The grains were found to consist of fragments (10^{-3} - 10^{-4} cm in size, differing strongly in orientation) which were in turn composed of mosaic blocks, i.e. regions which scatter X-rays coherently. The block sizes were 10^{-5} - 10^{-6} cm and their orientations differed only very slightly. Maximum hardness was obtained when the block dimensions were smallest. The temperature interval where these dimensions increased corresponded to softening of iron and its alloys. Breakup of fragments and blocks was accompanied by increase of their misorientation. There are 19 figures and 37 references: 21 Soviet-bloc and 16 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: W.G. Johnston and G.G. Gilman, J.Appl.Phys., 30, 2, 129, 1959; D.F. Stein and G.R. Low, J.Appl.Phys., 31, 2, 362, 1960; P.B. Hirsch, J.Inst. Metals, 8, 406, 1959; W. Bollman, J.Inst.Metals, 8, 439, 1959.

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S/717/62/000/007/002/010
D207/D301

AUTHORS: Il'ina, V.A., Kritskaya, V.K., Candidate of Physico-Mathematical Sciences, Kurdyumov, G.V., Member of the Academy of Sciences, USSR, and Osip'yan, Yu.A.

TITLE: On the nature of changes of Young's modulus and the characteristic temperature due to heat treatment of nickel-based solid solutions

SOURCE: Dnepropetrovsk. Institut metallovedeniya i fiziki metallov. Problemy metallovedeniya i fiziki metallov, no. 7, Moscow, 1962, 34 - 63

TEXT: Mechanical and other properties of nickel and its alloys were investigated as a function of their heat treatment and in relation to their microstructure. Apart from nickel, the following nickel alloys were studied: 1) With 2.9 % Al, 2), 5.7 % Al, 3) 11.5 % Cu, 4) 10.2 % Co, 5) 9.8 % Co, 6) 10.3 % Fe, 7) 14.5 % Mo, 8) 5.6 % Mo, 9) 20 % Cr. All these alloys contained also small amounts of C, Si, Mn, P and S. They were prepared in a high-frequency furnace, subjec-

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D207/D301

On the nature of changes of Young's ...

ted to homogenizing annealing (24 hours at 1200°C), forged, rolled and drawn into wires of 1 and 0.7 mm diameter. The following properties were studied: Young's modulus and its temperature dependence, shear modulus, internal friction, electrical resistance, Debye-Waller temperature factor, Debye characteristic temperature, and microstructure. Increases of Young's modulus, the Debye-Waller temperature factor and the Debye temperature were observed on heating, following deformation and quenching of the Ni-Cr (nichrome) alloy and on heating, following deformation of the Ni-Al and Ni-Cu alloys. The increases were due to redistribution of the component atoms leading to formation of the K-state. Young's modulus, its temperature dependence, shear modulus and internal friction of the ferromagnetic Ni-Al, Ni-Cu Ni-Co and Ni-Mo solid solutions were all affected by the rate of cooling from 300 - 400°C. Slip lines were observed after quenching of these ferro-magnetic alloys. The changes in the elastic constants and internal friction were due to defects formed on quenching which affected magnetostrictive and elastic properties of the ferromagnetic alloys. There are 26 figures, 2 tables and 30 references: 22 Soviet-bloc and 8 non-Soviet-bloc. The references to the English-lan-

Card 2/3

On the nature of changes of Young's ... S/717/62/000/007/002/010
D207/D301

guage publications read as follows: A. Taylor, and K. Hinton, J.Inst. Metals, 81, 4, 169, 1952-3; F. Nordheim and N. Grant, J.Inst.Metals, 82, 9, 440, 1953-4; S. Siegel and S. Quimby, Phys.Rev., 49, 663, 1936

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40971

S/659/62/009/000/001/030
1003/1203

AUTHORS Kurdyumov, G. V. and Perkas, M. D

TITLE On strengthening and softening of metals

SOURCE Akademiya nauk SSSR. Institut metallurgii Issledovaniya po zharoprochnym splavam. v. 9. 1962. Materialy Nauchnoy sessii po zharoprochynm splavam (1961 g.), 3-14

TEXT The resistance of metals and alloys to deformation is influenced by two factors: 1) the dimensions of the blocks of the mosaic structure and 2) properties of the crystal which determines its resistance to dislocation movements. This influence is additive. Discussion:- I. Ya. Dekhtyar expressed the opinion that there must also be short and long-range orders in the metals, and proposed checking the relationship between the properties investigated by the authors and the order of the crystal lattices of the metals. I. A. Oding stated that superstrength metals with no dislocations can be produced, and stressed the difficulties which may arise if the problem of increasing the elasticity modulus of these metals remain unsolved. A V. Stepanov suggested that the possibility of producing superstrength materials should be investigated by producing new modifications of such non-metals as sulfur using high temperatures and pressures, like the carbon modification of diamond He claims that this hypothetical sulfur modification would have a melting point of 35000°K, and better mechanical properties than diamond. According to I. A Gindin, the most effective method for obtaining a fine mosaic structure and thus increasing the creep resistance for pure metals is cold-working at low temperatures (77-4.2°K). There are 8 figures

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S/126/62/013/001/013/018
E091/E580

18.8200

AUTHORS: Il'ina, V.A., Kritskaya, V.K. and Kurdyumov, G.V.

TITLE: Study of the intensity of X-ray diffraction lines of cold worked metals

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.1, 1962, 132-136

TEXT: In previous papers the authors reported on changes of the integrated intensity of diffraction lines obtained with Mo-Kα radiation on α-iron. It was found by both photographic and ionization methods that plastic deformation of iron caused a decrease in intensity, the effect being the greater the higher the order of reflection. In the present study, the use of a scintillation counter and monochromatic irradiation enabled a more accurate study of changes in the intensity and the shape of lines. Powders of α-iron and other metals, both cold worked and annealed, were investigated. X-ray diffraction patterns of the same materials were also photographed, and the relative intensities of a number of lines were determined. The results obtained varied: using the photographic method, a weakening of the integrated intensity was observed after deformation, whereas the scintillation X